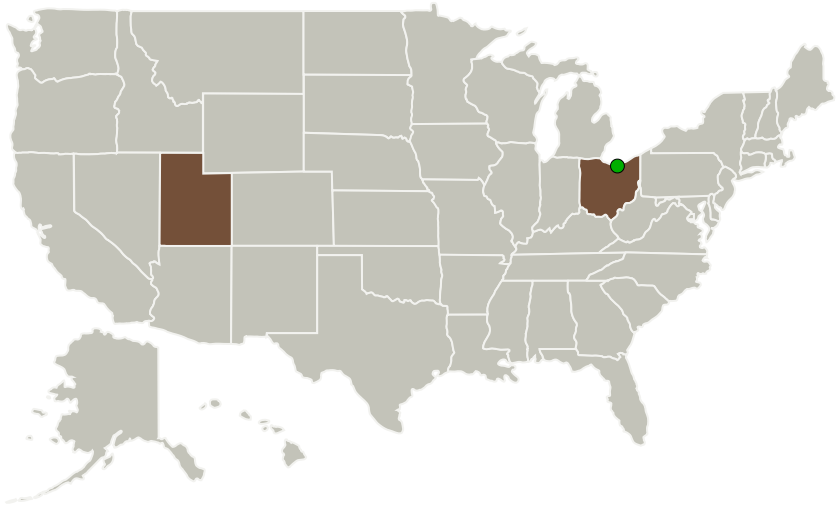
Development of a Robust, Highly Efficient Oxygen-Carbon Monoxide Cogeneration System, Phase I

Completed Technology Project (2011 - 2011)

Project Introduction

This small business innovation research is intended to develop a long-life, highly efficient O2-CO cogeneration system to support NASA's endeavors to pursue extraterrestrial exploration (Moon, Mars, and Asteroids/Phobos). The cogeneration system will be built using a Tubular, Negative Electrode-supported Solid-Oxide Electrolysis Cell (Tune-SOEC) employing MSRI's most promising degradation-resistant ceramic materials and a unique cell design. The system will be capable of co-generating breathable oxygen and CO fuel directly from carbon dioxide extracted from the Martian atmosphere, lunar regolith/soil, or from the cabin air of extraterrestrial human missions at 750~850ºC. In Phase I, CO2 electrolysis degradation mechanisms will be investigated via nonequilibrium thermodynamic analyses and tests of Tune-SOECs with special embedded reference electrodes. Unique solutions for long-term, high performance CO2 electrolysis will be developed and implemented. In Phase II, a prototype O2-CO cogeneration system using the Tune-SOEC technology will be developed. A proof-of-concept system will be demonstrated, cogenerating O2-CO directly from a CO2 source at temperatures ranging from 750ºC to 850ºC; showing the capability of using ISRU to generate 1 kg oxygen per day (enough to support 1 human).

Primary U.S. Work Locations and Key Partners



Development of a Robust, Highly Efficient Oxygen-Carbon Monoxide Cogeneration System, Phase I

Table of Contents

Development of a Robust, Highly Efficient Oxygen-Carbon Monoxide Cogeneration System, Phase I

Completed Technology Project (2011 - 2011)

Organizations Performing Work	Role	Type	Location
Materials and Systems Research, Inc.	Lead Organization	Industry Minority-Owned Business	Salt Lake City, Utah
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Ohio	Utah

Project Transitions

February 2011: Project Start

September 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140218)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Materials and Systems Research, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

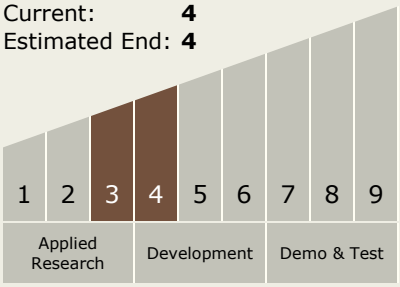
Carlos Torrez

Principal Investigator:

Greg Tao

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Development of a Robust, Highly Efficient Oxygen-Carbon Monoxide Cogeneration System, Phase I

Completed Technology Project (2011 - 2011)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System